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TITLE: OPTICAL RECORDING MEDIUM, INFORMATION PROCESSING APPARATUS USING SUCH RECORDING MEDIUM, AND RECORDING METHOD FOR DATA

Hon. Commissioner of Patents and Trademarks,
Washington, D.C. 20231

SIR:

CERTIFIED TRANSLATION

I, Chiharu Takahashi, am an official translator of the Japanese language into the English language and I hereby certify that the attached comprises an accurate translation into English of Japanese Application No. 2002-189347, filed on June 28, 2002.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signed this on the 19th day of July, 2006

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[Title of the Invention] Optical Recording Medium and Information Processing Apparatus

[Claims]

[Claim 1] An optical recording medium that data can be additionally written or rewritten in units of a block including a data group, the optical recording medium characterized in that:

buffer areas for random access are respectively provided preceding and following each block;

wherein, when recording a new block, recording is made with an overlap between the buffer area provided for the relevant block and the buffer area provided for an existing block adjacent the relevant block.

[Claim 2] An optical recording medium according to claim 1, wherein a recording unit block is constituted by a block and the buffer areas preceding and following thereto,

a guard area being provided in a last of one of the recording unit blocks or of a plurality of successive recording unit blocks.

[Claim 3] An optical recording medium according to claim 1, wherein the buffer area arranged immediately preceding the block has a guard area for an overlap for recording and a preamble for signal processing,

the guard area or the preamble recording therein a signal

pattern for data-reproducing phase-locked-loop frequency lead-in or auto gain control.

[Claim 4] An optical recording medium according to claim 1, wherein the buffer areas arranged immediately preceding or immediately following or arranged immediately preceding and immediately following the block have a guard area for an overlap for recording, a signal pattern for auto control related to light-source power being recorded in the guard area.

[Claim 5] An optical recording medium according to claim 1, wherein the buffer area arranged immediately preceding the block has a guard area for an overlap for recording and a preamble for signal processing,

a plurality of synchronism patterns different in distance from one another and identification information being recorded in the preamble.

[Claim 6] An optical recording medium according to claim 1, wherein the buffer area arranged immediately following the block has a post-amble for signal-processing temporal adjustment and a guard area for adjusting a recording end position,

the post-amble recording therein a signal pattern for phased locked loop related to a reproducing clock.

[Claim 7] An optical recording medium according to claim 1, wherein the buffer area arranged immediately following the

block has a post-amble for signal-processing temporal adjustment and a guard area for adjusting a recording end position,

the post-amble recording therein a signal pattern for detecting a reproducing end of the relevant block.

[Claim 8] An optical recording medium according to claim 3, wherein the signal pattern is a repetition pattern of 3T/3T/2T/2T/5T/5T.

[Claim 9] An optical recording medium according to claim 4, wherein the signal pattern is a repetition pattern of 3T/3T/2T/2T/5T/5T.

[Claim 10] An optical recording medium according to claim 6, wherein the signal pattern is a repetition pattern of 3T/3T/2T/2T/5T/5T.

[Claim 11] An information processing apparatus for recording or reproducing information to an optical recording medium that data can be additionally written or rewritten in units of a block including a data group, the information processing apparatus characterized in that:

data recording means is provided to generate recording channel data added with a random-access buffer area in positions preceding and following each of blocks and to record the data to the optical recording medium,

wherein, when staring a recording of a new block to first and second blocks being already recorded, recording is made

with an overlap between the buffer area arranged immediately preceding the relevant block and the buffer area arranged immediately following the first block adjacent the relevant block while, when ending a recording of the block, recording is made with an overlap between the buffer area arranged immediately following the relevant block and the buffer area arranged immediately preceding the second block adjacent the relevant block.

[Claim 12] An information processing apparatus according to claim 11, wherein recording and reproducing are made in units of a recording unit block including the block and the buffer areas preceding and following thereto,

wherein, when recording of recording channel data, a guard area is provided to a last of one recording unit block or of a plurality of successive recording unit blocks.

[Claim 13] An information processing apparatus according to claim 11, wherein the buffer area arranged immediately preceding the block has a guard area for an overlap for recording and a preamble for signal processing,

data reproducing means being provided to reproduce a signal pattern recorded in the guard area or the preamble and to use same as a signal for phase-locked-loop frequency lead-in and auto gain control.

[Claim 14] An information processing apparatus according to claim 11, comprising data reproducing means to reproduce

a signal pattern recorded in the guard area for an overlap for recording of the buffer area arranged immediately preceding or immediately following or arranged immediately preceding and immediately following the block, and to use same as a signal for auto control related to light-source power.

[Claim 15] An information processing apparatus according to claim 11, wherein data reproducing means is provided to reproduce a plurality of synchronism patterns recorded in the preamble for signal processing of the buffer areas arranged immediately preceding the block and to establish a synchronism.

[Claim 16] An information processing apparatus according to claim 11, wherein data reproducing means is provided to reproduce a signal pattern recorded in the post-amble for signal-processing temporal adjustment of the buffer areas arranged immediately following the block and to use same in a phased locked loop of a reproducing clock.

[Claim 17] An information processing apparatus according to claim 11, wherein data reproducing means is provided to reproduce a signal pattern recorded in the post-amble for signal-processing temporal adjustment of the buffer areas arranged immediately following the block and to detect a reproducing end as to the relevant block.

[Detailed description of the Invention]

[0001]

[Technical field to Which the Invention Belongs]

The present invention relates to a block-to-block linking art that allows data additional write or rewrite onto an optical recording medium made recordable.

[0002]

[Prior Art]

Recently, a variety of digital medias have been disseminated, including DVDs (Digital Versatile disks). There are practical applications of recordable-optical-disk recording/reproducing apparatuses large in capacity arranged for additionally writing and rewriting data onto the optical disk, e.g. DVD-RW (ReWritable). In the apparatus of this kind, data is to be written basically on the basis of an error-correction-code (ECC) with reference to block-address positional information provided on the pit previously formed on the disk or in the wobbled groove or the land, etc.

[0003]

In such a case, there is a need to consider a scheme of linking between the blocks. As for linking, roughly two schemes have been proposed so far.

[0004]

One of these is a scheme that emphasis is placed on the compatibility with a read-only optical disk so that blocks can be written continuously freely from interruptions without using linking areas. The examples using such a scheme include

those of DVD-R, DVD-RW and DVD+RW.

[0005]

In another scheme, there exist, between blocks, linking areas, pits previously made for use in information addressing or so or gaps thereof, while ignoring the compatibility with a read-only reproducing apparatus for a read-only-optical-disk. For example, DVD-RAM falls under the scheme.

[0006]

[Problem that the Invention is to Solve]

In the meanwhile, the conventional scheme involves, say, the following problems in respect of compatibility and random access capability.

[0007]

Firstly, in the scheme of continuously writing blocks freely of linking areas at between blocks, higher positional accuracy of writing is required for random-access block writing as compared to the scheme with using linking areas. The circuit for the purpose is further complicated, thus being non-advantageous in respect of cost. Meanwhile, during reading, there is a possibility to cause a discontinuity in channel-bit phase between the block-to-read and the preceding block. Unless taking such a measure as to restrict the relationship of channel-bit phase between blocks, e.g. successively writing the block-to-read and the preceding

block, the discontinuity of channel bit phase between blocks acts as a disturbance against read-clock PLL (Phase Locked Loop). In the duration before reaching a steady state of PLL, data reading remains instable thus resulting in a fear to cause errors in read-out data. However, if providing a restriction to the channel-bit-phase relationship between blocks, random access capability and on-disk data storage efficiency are lost, e.g. writing is needed also to the block preceding the block-to-write as a dummy block.

[0008]

Meanwhile, in the scheme involving vacancies existing between blocks, where to reproduce a recordable optical disk by use of an read-only reproducing apparatus for a read-only optical disk, the difference of physical specifications must be considered between a recordable optical disk and a read-only optical disk. For example, a reproducing-system circuit such as of auto gain control (AGC) must be designed in consideration of the region where the reproduced waveform is free of amplitude, i.e. gaps. This makes it necessary to switch over the circuit operation mode or the circuit itself, between a reproduction from a read-only optical disk and a reproduction from a reproducible/recordable optical disk, leading to a cost rise of the apparatus.

[0009]

As described above, in the conventional linking scheme,

it is the current situation to select either one of hardware compatibility with a read-only optical disk or random access capability where emphasis is placed on cost.

[0100]

Therefore, the present invention aims at realizing a block-to-block linking scheme excellent in the compatibility with a read-only optical disk and possessing a random access capability for recording and reproducing, in a recordable-optical-disk recording/reproducing apparatus, etc. for performing additional write and rewrite to a recordable optical disk.

[0011]

[Means for Solving the Problem]

The present invention possesses the following where to perform an additional writing or rewriting data based on a block containing a data group to an optical recording medium.

[0012]

- Buffer areas for random access are respectively arranged in positions preceding and following each of blocks.

[0013]

- When starting to record a new block to first and second blocks already recorded, recording is made with an overlap between the buffer area arranged immediately preceding the relevant block and the buffer area arranged immediately following the first block adjacent the relevant block. When

the relevant block is ended from recording, recording is made with an overlap between the buffer area arranged immediately following the relevant block and the buffer area arranged immediately preceding the second block adjacent the relevant block.

[0014]

Accordingly, in the invention, by providing buffer areas in positions preceding and following the block, random access is easy to perform. Linking areas are formed based on the buffer areas overlapped together, thus preventing vacancies from occurring between blocks.

[0015]

[Mode for Carrying Out the Invention]

The present invention is concerned with an optical recording medium that data is to be additionally written or rewritten in units of a block containing a data group, and with an information processor using same. For example, in the application for a recordable-optical-disk recording/reproducing apparatus adapted to additionally write or rewrite data onto a recordable optical disk, a block-to-block linking scheme is proposed which maintains the compatibility with a read-only optical disk and provides the capability of random access for recording or reproducing.

[0016]

Note that the optical recording medium in the invention

is to take any form and hence applicable to various forms including a tape form, a card form or the like without limited to the disk form.

[0017]

The linking scheme in the invention is to provide a buffer having a sufficient size for making easy a perfect random access to implement, in a position preceding and following a block containing a data block. Namely, buffer areas for random access are arranged in respective positions preceding and following each of blocks.

[0018]

From now on, the buffer area located preceding a block is referred to as a "data run-in" while the buffer area located following the block is as a "data run-out". As for those buffer areas, recording is made with an overlap with the adjacent existing blocks when starting or terminating a recording, as shown in Fig. 1.

[0019]

In the concept figure shown in Fig. 1, "BLK", "BLK1" and "BLK2" represent blocks, "DRi" a data run-in and "DRo" a data-run-out, respectively.

[0020]

The process unit (recording-unit block), concerned with recording-channel or reproducing-channel data, is constituted by a block and buffer areas existing in front and

back thereof. For example, as for the BLK, it is constituted by three, i.e. with the data run-in DRi located in front thereof and the data run-out DRo located in back thereof. Note that, in the figure, the three recording-unit blocks are provided intentionally deviated for the sake of easy viewing (the recording-unit block will be detailed in the "RUB" shown later).

[0021]

"Ov" represents a range of an overlap with the data run-in and data run-out. When to start a new recording of a block BLK to the existing block, recording is made with an overlap of the data run-in located preceding the relevant block with the data run-out located following the adjacent block BLK1 (existing preceding block) to the relevant block. Meanwhile, when to terminate the block BLK from recording, recording is made with an overlap of the data run-out located following the relevant block with the data run-in located preceding the adjacent block BLK2 (existing succeeding block) to the relevant block.

[0022]

In this manner, when starting a block recording, the buffer area is overlapped with the preceding block to the block to start the recording. When terminating the block recording, the buffer area is overlapped with the block next to the block to terminate the recording. This provides an assurance not

to cause gaps between the blocks.

[0023]

A linking area is constituted by a buffer area already recorded concerning the recording-unit block and a buffer area of the block to newly record (e.g. constituted by a data run-out of the preceding recording-unit block and a data run-in of a new recording-unit block).

[0024]

The overlap, occurring upon recording, is not an overlap existing throughout the entire range of the buffer area but is caused in part of the buffer area. On this occasion, the region out of the overlap (region in the data run-in) has a sufficient length as a buffer area for signal processing, such as PLL synchronism lead-in. For example, in a structure having a guard area for recording overlap and a signal-processing preamble in concerned with a data run-in located immediately preceding a block, a signal pattern for data-reproducing PLL synchronism lead-in and AGC can be recorded in the guard area or the preamble.

[0025]

For a pattern suited for reproducing PLL lead-in and AGC, it is preferable to use a repetition pattern of 3T/3T/2T/2T/5T/5T shown in Fig. 2 ("T" designates a data bit interval wherein status inversion occurs at "1").

[0026]

Namely, although mark length is preferably short for PLL lead-in, AGC requires an RF (radio frequency) signal in a level to saturate the amplitude. For meeting the both requirements, a repetition pattern 3T/3T/2T/2T/5T/5T is suitable.

[0027]

Meanwhile, during data recording, the data run-in can be used also in auto control of laser power (AGC: auto power control). For example, where the data run-in has a guard area for a recording overlap, it is satisfactory to record in the relevant area a signal pattern for auto control of light-source power.

[0028]

Without limited to data run-in, multi-purpose utilization is available as for data run-out.

[0029]

The data run-out is a buffer area to cope with the variation in recording position caused due to SPS or recording-start positional accuracy, similarly to the data run-in. Note that "SPS" is a start position shift that signifies a shift of a start point in the recording-unit block in an amount of random channel bit from the regulated start position in order to avoid the disk from excessively fatiguing.

[0030]

The data run-out can be used as a temporal buffer area

for the processing requiring time, e.g. waveform equalizing and Viterbi decoding processes during reproducing. Where the data run-out has a post-amble for temporal control in signal processing, it is satisfactory to record in the post-amble a PLL signal pattern related to a reproducing clock. The pattern preferably uses a repetition pattern 3T/3T/2T/2T/5T/5T suitable for the PLL of the reproducing clock used in a processing requiring time, e.g. waveform equalizing and Viterbi decoding processes in reproducing.

[0031]

Meanwhile, when terminating the block recording, the data run-out is to be used also in laser-power APC.

[0032]

The linking scheme, proposed in the invention, provides means for intensifying the data-synchronism establishment for reproduction. For example, in a data run-in, the preamble for signal processing is to record a plurality of synchronism pattern different in distance and identification information (number) from one another. Namely, data synchronism is to be intensely established by enforcing the synchronism establishing means utilizing a plurality of features, including sync pattern-to-pattern distance and sync ID number besides the pattern for establishing a synchronism (hereinafter, referred to as a "sync pattern) itself (the detail of which will be described later).

[0033]

Furthermore, in a data run-out, a plurality of means are provided to detect a fact the reproducing of block data is over. Namely, in a data run-out, a sync pattern is arranged to detect a termination of block reproduction. For example, as described later, where having a post-amble for signal-processing time regulation and a guard area provided for recording-end-point regulation, it is satisfactory to record in the post-amble a signal pattern to detect a termination of reproducing the relevant block (specifically, a block end can be detected by use of a repetition of 9T over 6 cycles as a unique pattern to the block).

[0034]

Fig. 3 is a diagram for explaining the overall structure and operation of an information processor 1 (information recording/reproducing apparatus) in one embodiment of the invention. Incidentally, the apparatus shown in the present embodiment is an optical-disk recording/reproducing apparatus incorporating therein hardware, including a CPU (central processing unit), a ROM (read only memory) and a RAM (random access memory).

[0035]

For an optical recording medium 2, there is provided a pickup (or optical head) 3 for reading out and writing information. By moving it along the radial direction of the

optical disk by means of a moving mechanism not shown, an objective lens is placed under positional control relative to the disk.

[0036]

Meanwhile, a spindle motor 4 is provided to rotate the optical recording medium 2. The motor 4 is under control of spindle servo means 5.

[0037]

The pickup 3 includes a laser, i.e. a light source, and light-receiving means, to focus the light beam emitted from the laser onto the optical recording medium 2 and to convert the reflection light of from the recording medium into a light-reception signal.

[0038]

For the pickup 3, servo control means 6 is provided to control the mechanism including an objective-lens-driving actuator and to control the feed of the pickup. The information read out of the optical disk is forwarded to reproduction-signal processing means 7.

[0039]

The reproduction-signal processing means 7 is configured with using a read-channel processor, etc., whose output is forwarded to wobble-signal detecting means 8, reproduction-data processing means 9 and servo control means 6.

[0040]

A wobble signal, detected by the wobble-signal detecting means 8 configured by a wobble processor, etc., is forwarded to wobble-information extracting means (address detector) 10 where extracted is information, such as of an address specifying an on-optical disk position.

[0041]

The wobble signal is configured with so-called a monotone signal part and a signal part that address information, representing a record or reproduction start point, is MSK-modulated. The wobble-information extracting means 10 detects and demodulates address information from the wobble signal and generates an address synchronism signal. Incidentally, although the period of the wobble signal is considered at various values, one wobble (wobble period) herein is assumably constituted with 69 channel bits that is a value suited where considering the effect exerted upon recording or reproducing the channel bits and address information amount.

[0042]

The address information, detected by the wobble-information extracting means 10, is forwarded to timing (signal) generating means 11 where a data-recording-and-reproducing timing (read-write timing) signal is generated based on the address information. The

signal is forwarded to the reproduction-data processing means 9 and the recording-data processing means 12. Incidentally, the timing generating means 11 generates a recording-position control signal synchronism with the address synchronism signal and recording clock according to a reproduction-start address instruction, etc. The signal is outputted to a modulation and synchronism signal generating section in the recording-data processing means 12 and to a demodulation-and-synchronism detecting section in the reproduction-data processing means 9.

[0043]

The reproduction-data processing means 9 receives the signal from the reproduction-signal processing means 7 and performs a processing of demodulation, synchronism detection, ECC (error correction code) decoding and so on.

[0044]

The recording-data processing means 12 performs the processing of data modulation, synchronism signal generation, ECC coding and so on, and forwards a processing result (recording signal) to laser drive means 14.

[0045]

Recording-reference clock generating means 13 is to generate a recording reference clock from the wobble signal of from the wobble-signal detecting means 8. Base on the recording clock signal, signal processing is made on the data

to be recorded onto the optical recording medium 2. The recording-reference clock generating means 13, usually, is configured by a PLL circuit, whose output signal is forwarded to the recording-data processing means 12 and laser drive means 14.

[0046]

The laser drive means 14 is to drive the laser source of the pickup 3, to control the intensity and beam amount to a desired value and to modulate the laser beam depending upon record data during recording.

[0047]

As a controller 15, there are provided a controller including interface means to an external host apparatus (host computer, etc.) 16 and a controller including interface means to a microcomputer for focus and tracking servo.

[0048]

Recording process is performed mainly by the recording-data processing means 12. Using as a reference signal the recording clock signal of from the recording-reference clock generating means 13, the processing of ECC coding, interleave, DC (direct current) control and (1, 7) PP modulation is performed herein on the recording user data inputted from the controller 15 ("PP" signifies "Parity preserve/Prohibit RMTR). Then, by generating and adding a synchronism pattern, a data run-in and a data run-out,

recording channel data is generated (incidentally, the recording/reproducing-channel data will be detailed later).

[0049]

Namely, the recording-data processing means 12 constitutes data recording means 17 for the optical recording medium 2, cooperatively with the recording-reference clock generating means 13, the laser drive means 14, the pickup 3 and so on. There is generated recording channel data that random-access buffer areas are added in positions preceding and following each of blocks (data blocks), to record information containing data, sync patterns, etc. to the optical recording medium 12. Incidentally, as for the recording-unit block, a guard area is provided to the last of one recording-unit block or of a plurality of successive recording-unit blocks (see Figs. 4 and 5) though referred later.

[0050]

The controller 15 is connected to the host apparatus 16, e.g. host computer, through the interface, to exchange data with the apparatus and take control of the optical-disk recording/reproducing apparatus overall.

[0051]

During reproducing, illumination control is performed on the optical beam of from the pickup 3 to a desired point on the optical recording medium 2. For this purpose, a servo

signal is used that is sent from the reproduction-signal processing means 7 to the servo control means 6.

[0052]

The reproduction-signal processing means 7 processes the reception-light signal of from the pickup 3, to generate a reproduced signal, a push-pull signal and a servo signal. In the reproduction-signal processing means 7 performs the processing of AGC (automatic gain control), AD (analog-digital) conversion, waveform equalization and Viterbi decoding on the reproduced signal, to reproduce reproducing-channel data.

[0053]

The reproduction-data processing means 9, in the rear stage, detects a synchronism pattern out of the reproducing-channel data depending upon the reproduced timing signal of from the timing generating means 11, and performs a (1, 7) PP demodulation processing, thus reproducing user data through the processing of interleave (de-interleave) and ECC decoding. The user data is transferred to the host apparatus 16 through the controller 15.

[0054]

The reproduction-signal processing means 7 and the reproduction-data processing means 9 cooperate with the pickup 3, etc., to constitute data reproducing means 18 for the optical recording medium 2. It performs the main process

of restoring information and various signal processes associated therewith.

[0055]

For example, it performs a processing of reproducing a signal pattern recorded in the data run-in and using it as a signal for PLL lead-in and AGC, or reproducing a signal pattern recorded in the data run-in or data run-out and using it as a signal for light-source-power APC.

[0056]

Besides, in the data run-in, reproduction is made of a plurality of synchronism patterns recorded in a signal-processing preamble to thereby make a processing for synchronism establishment. Otherwise, in the data run-out, reproduction of a signal pattern recorded in a signal-processing time-adjusting post-amble is made to thereby make a processing needed for generating a reproducing clock, or a role is to be played for detecting a reproducing end concerning the relevant block.

[0057]

Incidentally, for a push-pull signal to generate in the reproduction-signal processing means 7, the reflection light from the optical recording medium 2 is received by a light-receiving element divided into two parts with respect to a direction parallel with the track tangential direction, to detect a differential signal between the outputs of from

the two-divided light-receiving element. A wobble signal is extracted from the push-pull signal by a BPF (abbreviation of "band pass filter).

[0058]

Meanwhile, the spindle motor 4 and the spindle servo means 5 constitute optical-disk-rotation control means, to control the rotation of the optical disk in a manner bringing the wobble signal to a predetermined frequency (the optical disk on a turntable rotated by a spindle motor 4 is rotatively driven depending upon the control signal of from spindle-servo means 5).

[0059]

Using Figs. 4 to 10, explanation is now made on the detail of the recording-channel/reproducing-channel data.

[0060]

Incidentally, the user data (application software or the data to be delivered to/from the host apparatus) is formatted in some stages prior to recording to the optical recording medium, e.g. conversion is made continuously in the order of "data frame or scrambled data frame → data block → LDC block → LDC cluster". Here, "LDC" is an abbreviation of "Long Distance error Correction code", to remove both of random and burst errors.

[0061]

Meanwhile, a DVR (Digital Video Recording) address and

control data is converted continuously in the order of "address block → BIS block → BIS cluster". Here, "BIS" means a burst indicator sub-code. The BIS code word, including an address and control data conforming to the user data, is to be used in detecting a long burst error.

[0062]

The LDC cluster and the BIS cluster are multiplexed and modulated into an ECC cluster.

[0063]

In the DVR, data is recorded by a division in units (64 k) called "physical cluster". The physical cluster includes 32 data frames having 2048 bytes of user data (data is protected by LDC and BIS error correction).

[0064]

Every data is configured as one array as shown in the below Table 1. The data is read out laterally of the Table. After added with DC-component control bits (depending upon DSV), modulation is done. After inserting a synchronism pattern, recording is made onto the disk.

[0065]

[Table 1]

[0066]

Incidentally, in the Table, "sync" represents a synchronism part (sync), "DX" (X = 0, 1, 2, ...) an LDC code

word, and "BX" (X = 0, 1, 2, ...) a BIS code word.

[0067]

As for the LDC code word, interleave has been done diagonally of Table 1. The physical cluster in the whole, for addressing, is segmented into 16 address units (or physical sectors) each formed by successive 31 rows.

[0068]

The recording-channel data and the reproducing-channel data are in units of recording-unit block (hereinafter, abbreviated as "RUB"). From now on, this is abbreviated as "RUB". The RUB begins with a data run-in area having 2760 channel bits, continued by a cluster (physical cluster) as a set of modulated user data and its synchronism patterns, and terminates with a data run-out area having 1104 channel bits.

[0069]

In the channel bit example schematically shown in Figs. 4 and 5, "1" represents an RUB. Following the data run-in shown at "2", a cluster shown at "3" comes, followed by a data run-out shown at "4". Incidentally, those numerals are signs attached to the respective parts (it is noted that the numeral in the brackets itself does not have any meaning).

[0070]

The data run-in "2" and the data run-out "4" are to offer a sufficient buffer area for perfect random write or facilitate overwrite.

[0071]

The RUB "1" is recorded in a predetermined position designated by an on-disk address, block by block or as a successive sequence of a plurality of blocks. Namely, the RUB is recorded singly or as a successive sequence of a plurality of RUBs (namely, the rub(s) exists one or in a plurality successively). Where the RUB is one in the number, a guard area (designated at "5") is located in the last of the relevant RUB. For a plurality of successive RUBs, a guard area "5" is located in the end of the last RUB. In brief, the RUB located in the last records therein a guard area. However, the guard area "5" is an area assuring that no vacancy occurs at each of between two RUBs, whose length is 540 channel bits.

[0072]

Fig. 4 shows a case that one block of RUB is recorded at from a RUB address of N (representing a recording start point of the RUB). Immediately following the data run-out of the RUB, a guard area "5" is located.

[0073]

Meanwhile, Fig. 5 shows a case that M blocks (M: natural number of 2 or greater) of RUBs are sequentially recorded at from a RUB address of N. Immediately following the "N+M"-th RUB, a guard area "5" is located. In the case of recording successive blocks in the number of M, there occur no overlaps of data run-in and data run-out at between adjacent ones of

the blocks.

[0074]

Fig. 6 shows a structure of within one cluster, wherein cluster "3" is formed with a plurality of frames shown at "6", "6", ...

[0075]

For example, the RUB "1" is configured with frame "6" in the number of 496. The frame "6" is formed with frame data shown at "8" and its synchronism signal, or sync "7". The sync is an FS (frame sync).

[0076]

The recording frame modulated starts with an FS having 30 channel bits, to defione seven patterns of FS0 to FS6 as shown in the below Table 2. It has a 24-bit pattern (body) not conforming to the (1, 7) PP modulation rule and a 6-bit "Signature" representative of an ID (identification information).

[0077]

[Table 2]

[0078]

Incidentally, the FS has a pattern (sync pattern) defined by modulated bits wherein "1", shown in the bit example in the above table, represents a signal inversion. Prior to recording to the disk, the frame sync code is converted into

an NRZI channel bit stream.

[0079]

Meanwhile, because seven types of FSs are insufficient for identifying 31 recording frames, identification is made by a plurality of combinations of FSs.

[0080]

The first recording frame of each physical sector is given as FS0 (unique frame sync). The other frames are as per the showing in the below table (showing a relationship of an FS with a frame number).

[0081]

[Table 3]

[0082]

Using the above table, recording frames can be identified by combining a sync of a certain frame with a sync of the preceding frame. An FS can be specified from a combination of a sync related to frame number n with a sync related to any number of n-1, n-2, n-3 and n-4. For example, provided that the present frame number is 5, even where sync (FS1, FS2, FS3) is lost from the preceding first, second and third frames, frame identification is possible from the sync (FS3) of the one preceding, or fourth, frame and the sync (FS1) of the present frame (fifth frame) (when FS1 comes following FS3, occurrence is possibly only at a particular point in the above

table, i.e. at frame numbers 4, 5).

[0083]

The above description of the RUB is on the premise of an SPS (start position shift) of maximally ±2 wobbles and a recording-and-reproducing positional accuracy of ±0.5 wobble. In this case, the overlap between the RUBs, in a random-access recording, is given in a range of from 3 to 13 wobbles. Meanwhile, the data run-in not overlapped has a minimal length of nearly 27 wobbles. This length corresponds to nearly one recording frame, which length is sufficient for a buffer area for signal processing such as of PLL synchronism lead-in.

[0084]

Fig. 7 shows a structure of a data run-in.

[0085]

A data run-in "2" has a guard area (1100 channel bits) shown at "11" and a preamble (1660 channel bits) shown at "12". The guard area "11" is a buffer area for an overlap resulting from SPS or start position accuracy upon an overlap-recording operation. Meanwhile, the preamble "12" is a buffer area for signal processing (lock, synchronism).

[0086]

The guard area "11" has a length of 1100 channel bits, whose channel bit pattern is a repetition of $01[0]^2 1[0]^2 10101[0]^4 1[0]^3$ over 55 cycles. Here, in the representation $01[0]^2 1[0]^2 10101[0]^4 1[0]^3$, 0 and 1 represent

non-inversion and inversion of a write-channel bit string to the disk with NRZI (Non-Return to Zero Inverted). Meanwhile, the brackets and the following superscript number represent the number of repetition cycles of the in-bracket pattern over the superscript number.

[0087]

The repetition pattern $01[0]^2 1[0]^2 10101[0]^4 1[0]^3$ provides a repetition of 3T/3T/2T/2T/5T/5T (see Fig. 2). This pattern is a pattern suited for processing of reproducing PLL lead-in and AGC. Namely, mark length is preferably short for the PLL lead-in purpose. However, for AGC, an RF signal is needed in a level the amplitude saturates. The repetition pattern $01[0]^2 1[0]^2 10101[0]^4 1[0]^3$ is a suitable pattern for such a requirement, i.e. a suited pattern for the both features, i.e. as to reproducing PLL lead-in and AGC.

[0088]

Meanwhile, at a start of the recording sequence, the first five wobbles in the guard area "11" is to be used in laser-power auto control (APC). Namely, for a modulation bit pattern for used in APC, it is possible to desirably select $01[0]^2 1[0]^2 10101[0]^4 1[0]^3$ or the optimal pattern for APC.

[0089]

Fig. 8 shows a structure of a preamble.

[0090]

The preamble "12" has a length of 1660 channel bits. This

preamble is structured with a repetition pattern ($01[0]^2 1[0]^2 10101[0]^4 1[0]^3$) shown at "21", a synchronism pattern (sync) shown at "22", a repetition pattern (twice repetition of $01[0]^2 1[0]^2 10101[0]^4 1[0]^3$) shown at "23", a synchronism pattern (sync) shown at "24", and a repetition pattern (once repetition of $01[0]^2 1[0]^2 10101[0]^4 1[0]^3$) shown at "25". Here, the sync "22" and the sync "24" are given as FSs noted before. Under the FS rule, the sync "22" is FS[mod({N+4,7})] ("mod(x,a)" represents a surplus in a division of x by a) while the sync "24" is FS[mod({N+6,7})] (provided that X = 0 - 6, FS[X] corresponds to "FSX" in the Tables 2 and 3). Incidentally, this is for the case the first frame following the preamble "12" is FS[N]. For example, this means that, in the case the first FS following the preamble "12" (hereinafter, described as "FFS0") is FS0, the sync "22" is FS4 while the sync "24" is FS6.

[0091]

The sync "22", the sync "24" and the FFS0 obey the FS-generation rule and hence are different in ID from one another. Due to this, even where two of three synchronism patterns are not to be detected due to disturbance, in the case the remaining one synchronism pattern is detected and the synchronism pattern ID is normally read out, cluster synchronism can be established. Meanwhile, the sync "22", the sync "24" and the FFS0 are different in distance of one from

another (different in channel-bit spacing). Due to this, even where one of three synchronism patterns are not to be detected due to disturbance, even in the case the remaining two synchronism patterns are detected and the synchronism pattern ID is not normally read out, cluster synchronism can be established.

[0092]

Fig. 9 shows a structure of a data run-out.

[0093]

A data run-out "4" has a post-amble (564 channel bits) shown at "15" and a guard area (540 channel bits) shown at "16". The post-amble "15" is a temporal buffer area for a processing requiring time, e.g. reproducing waveform equalization or Viterbi decode. Meanwhile, the guard area "16" is a buffer area provided in consideration of the variation in recording position due to SPS or recording start position accuracy, similarly to the guard "11".

[0094]

Fig. 10 shows a structural example of a post-amble.

[0095]

The post-amble "15" is structured with a sync shown at "27", a unique pattern ($01[0]^{8}1[0]^{8}1[0]^{8}1[0]^{8}1[0]^{8}1[0]^{7}$) shown at "28", and a repetition pattern (repetition of $01[0]^{2}1[0]^{2}10101[0]^{4}1[0]^{3}$ over 24 cycles) shown at "29". Here, the sync "27" is FS0. Meanwhile, the unique pattern "28"

(repetition of 9T over six cycles) is a pattern unique to the RUB (pattern not to occur at other points in the RUB), which can be used in detecting a cluster end. The repetition pattern "29" is a suited pattern for reproducing clock PLL for use in a processing requiring time, e.g. reproducing waveform equalization or Viterbi decode.

[0096]

The guard area "5" (see Figs. 4 and 5) has a length of 540 channel bits, whose bit pattern is a 27-times repetition of $01[2]^2 1[0]^2 10101[0]^4 1[0]^3$ over 27 cycles. Meanwhile, in the last of a recording sequence, the last five wobblesin the guard area "5" is to be used in laser-beam APC. For a modulated bit pattern for use in APC, it is possible to desirably select $01[2]^2 1[0]^2 10101[0]^4 1[0]^3$ or the optimal pattern for APC.

[0097]

Accordingly, the above structure provides the following advantages.

[0098]

- In a large-capacity recordable-optical-disk recording/reproducing apparatus for additionally writing or rewriting data to a recordable optical disk, the compatibility on hardware is improved with a read-only reproducing apparatus exclusive for reading. Namely, there is no need to greatly modify the circuit configuration of the read-only reproducing apparatus in consideration of the existence of a reproduced

waveform gap due to the vacancies of between blocks. This allows the read-only reproducing apparatus to reproduce a recordable optical disk at a less additional cost.

[0099]

- Because of the excellence for random access, excellent performance can be exhibited as any of recordable-optical-disk recording/reproducing apparatus, including AV (audio-video) and computer storage applications.

[0100]

- Because the linking area can be used for multi-purposes, there requires less area not to be used for data recording, thus enabling efficient data recording.

[0101]

- By contrivedly arranging a plurality of synchronism patterns of data in the linking area, data synchronism can be established positively, to improve the readability of data during reproducing. Meanwhile, block-reproducing end can be positively detected so that the effect of out-of-synchronism due to defect, etc. is less exerted upon the following blocks, thus improving the readability of data during reproducing a sequence.

[0102]

[Effect of the Invention]

As apparent from the above description, the invention according to claims 1 and 11 facilitates random access by

providing buffer areas in positions preceding and following the block, thus being excellent in random access capability as compared to the scheme for continuously writing blocks without providing linking areas. By forming linking areas by means of overlapped buffer areas in a manner not to cause vacancies at between blocks, it is possible to prevent the adverse effect due to gaps in the reproduced waveform resulting from the existence of the vacancies (circuit-design change, circuit-operation-mode or circuit itself switching in accordance with vacant presence/absence, etc.), thus assuring the hardware compatibility. Moreover, it could not cause a conspicuous cost rise.

[0103]

The invention, according to claims 2 and 12, is assured not to cause vacancies between the adjacent ones of recording unit blocks.

[0104]

The invention, according to claims 3 and 13, can enhance the stability and reliability of data reading by recording a signal pattern for PLL or AGC in the buffer areas.

[0105]

The invention, according to claims 4 and 14, can stabilize the power at the light source.

[0106]

The invention, according to claims 5 and 15, can

positively take synchronism during reproducing data and improve the readability of data.

[0107]

The invention, according to claims 6 and 16, can obtain a signal for use in the reproduction process.

[0108]

The invention, according to claims 7 and 17, can positively detect a reproducing end of blocks and prevent the effect of out-of-synchronism from being exerted to the following blocks.

[0109]

The invention, according to claims 8, 9 and 10, can enhance the performance and reliability by use of the suitable pattern for the reproducing clock for use in PLL lead-in, AGC, APC and reproduction process.

[Brief Description of the Drawings]

[Fig. 1] A conceptional explanatory figure of a linking scheme according to the present invention.

[Fig. 2] An explanatory figure of a bit pattern suitable for PLL, AGC or the like.

[Fig. 3] A diagram showing an example of an apparatus configuration according to the invention.

[Fig. 4] A figure for explaining the channel data for recording and reproducing similarly to Figs. 5 to 10, the present figure being a figure showing a state that one block

of RUB is recorded.

[Fig. 5] A figure showing a state that a plurality of successive RUBs are recorded.

[Fig. 6] A figure showing a structural example of a cluster.

[Fig. 7] A figure showing a structural example of a data run-in.

[Fig. 8] A figure showing a structural example of a preamble.

[Fig. 9] A figure showing a structural example of a data run-out.

[Fig. 10] A figure showing a structural example of a post-amble.

[Description of Reference Numerals and Signs]

1 ... information processing apparatus, 2 ... optical recording medium, DRi, DRo ... buffer areas, 17 ... data recording means, 18 ... data reproducing means, "5" ... guard area, "11" ... guard area, "12" ... preamble, "15" ... post-amble, "16" ... guard area.

[Designation of Document] ABSTRACT

[Abstract]

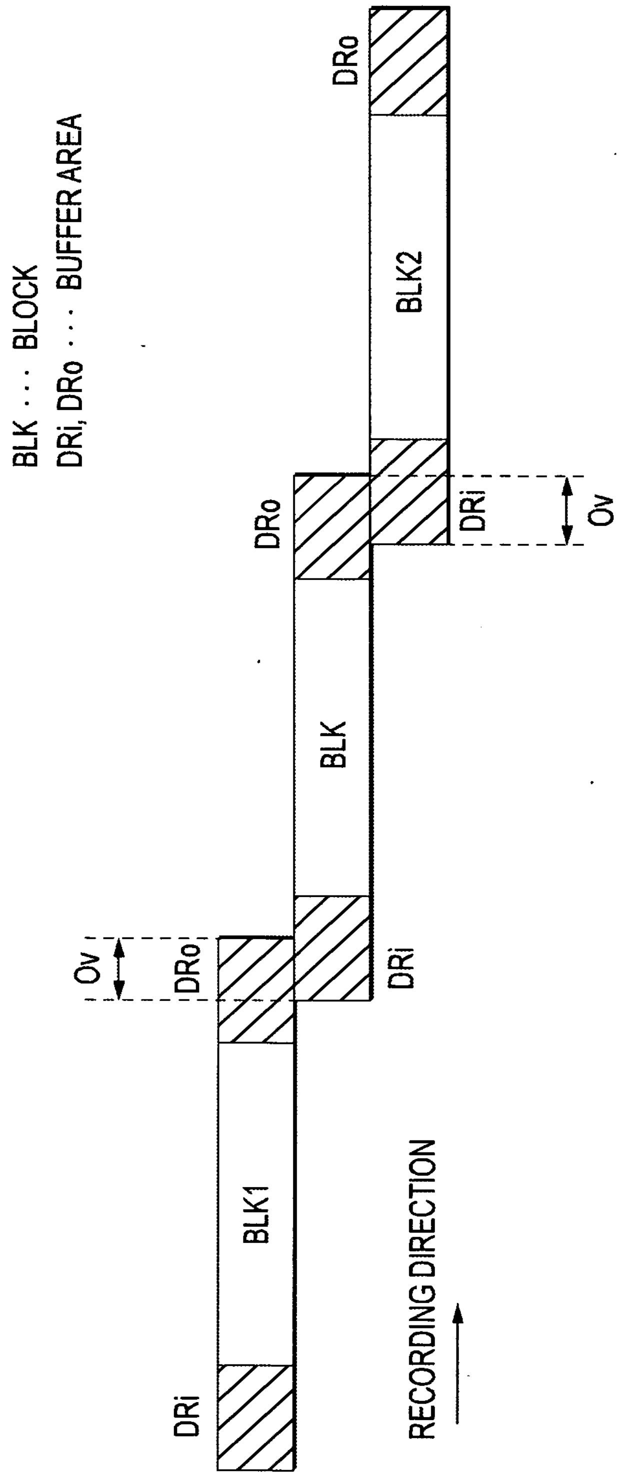
[Problem] To provide a block-to-block linking scheme excellent in the compatibility with a read-only optical disk and possessing a random access capability for recording and reproducing, in a recordable-optical-disk recording/reproducing apparatus, etc. for performing additional write and rewrite to a recordable optical disk.

[Means for Resolution] Buffer areas (data run-in DRi, data run-out DRo) for random access are respectively provided preceding and following each of blocks (BLK, BLK1, BLK2). When starting a new block recording, vacancies are prevented from occurring by making a recording with an overlap at the respective buffer areas of new and existing blocks. The buffer area can be utilized for various purposes by recording therein a signal pattern for use in data-reproducing phase-locked loop and auto gain control or light-source-power auto control or a signal pattern for detecting a synchronism pattern, regenerating clock generation or block reproducing end.

[Selected drawing] Figure 1.

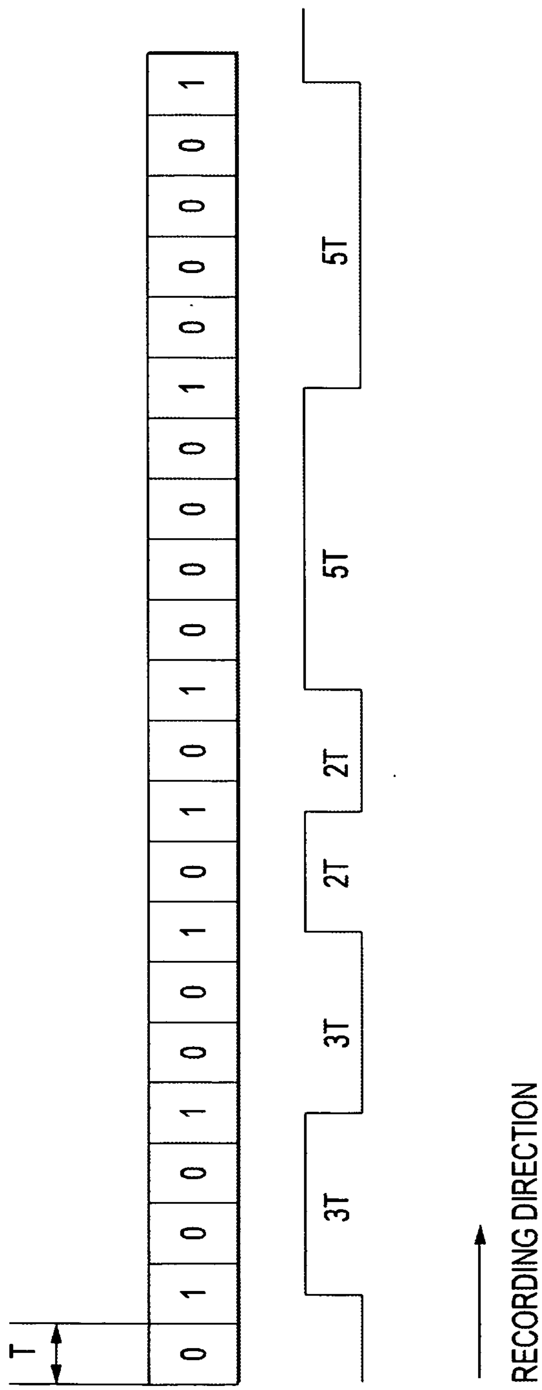
[DOCUMENT NAME] DRAWING

FIG. 1



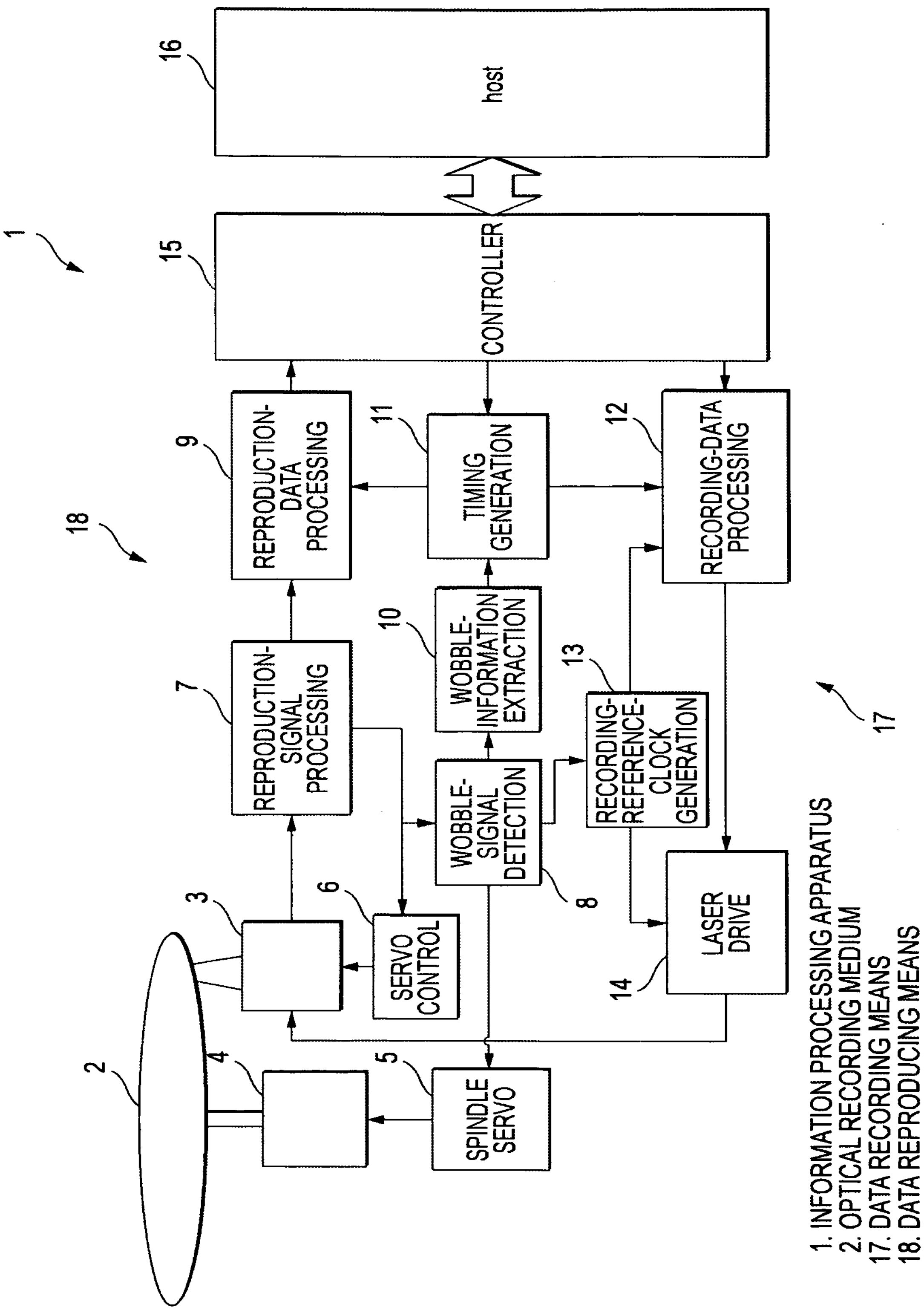
[DOCUMENT NAME] DRAWING

FIG. 2



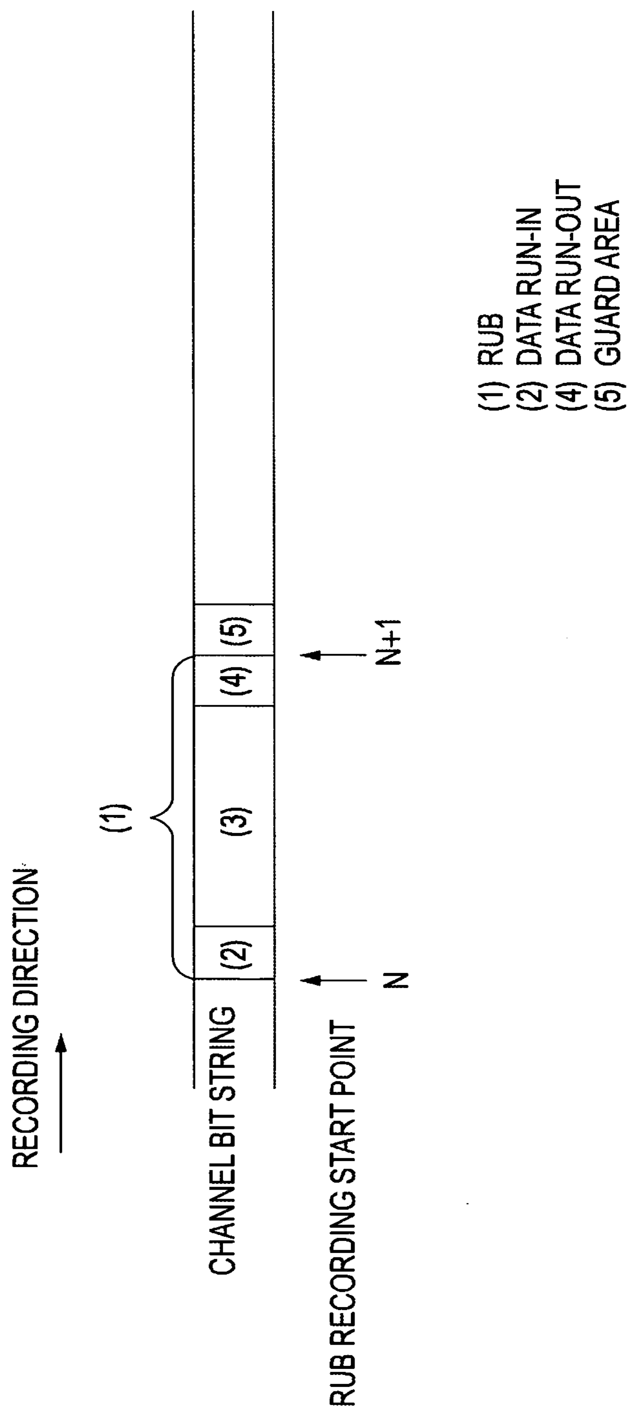
[DOCUMENT NAME] DRAWING

FIG. 3



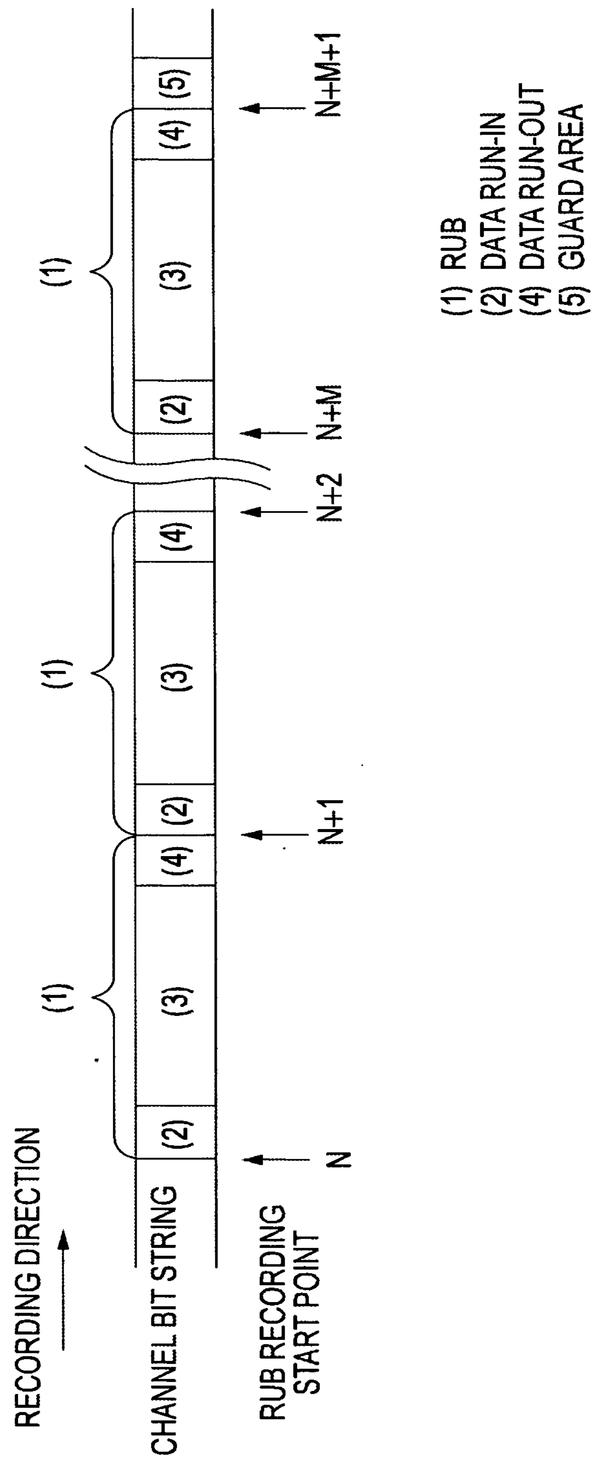
[DOCUMENT NAME] DRAWING

FIG. 4



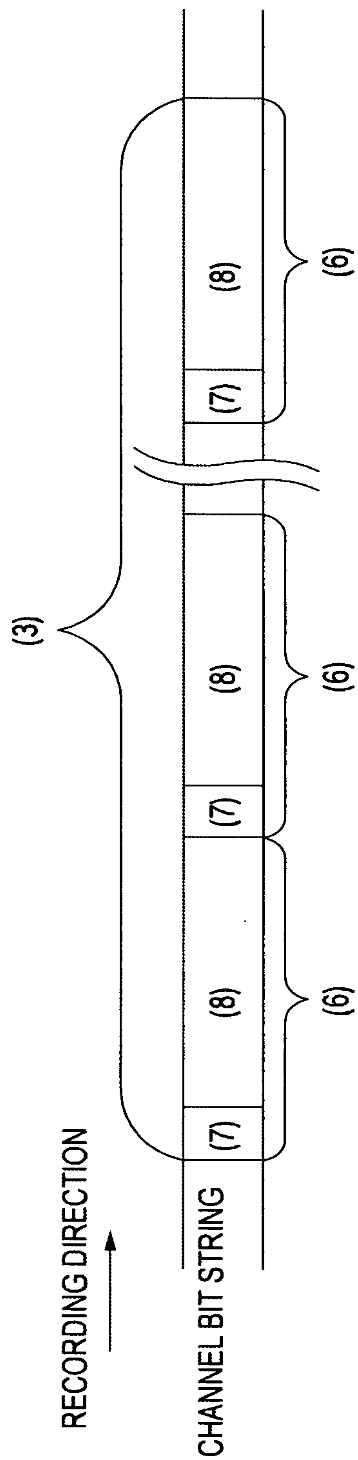
[DOCUMENT NAME] DRAWING

FIG. 5



[DOCUMENT NAME] DRAWING

FIG. 6



[DOCUMENT NAME] DRAWING

FIG. 7

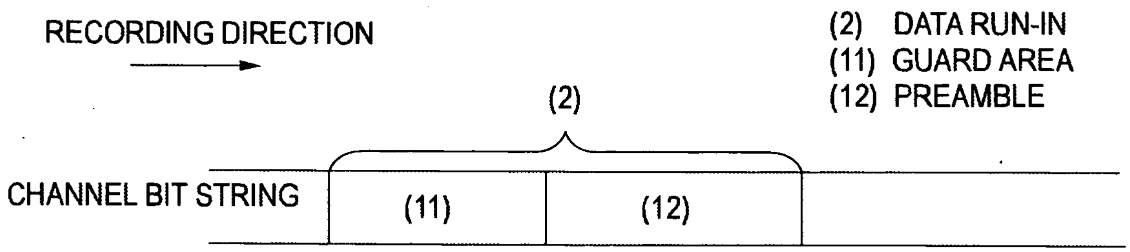


FIG. 8

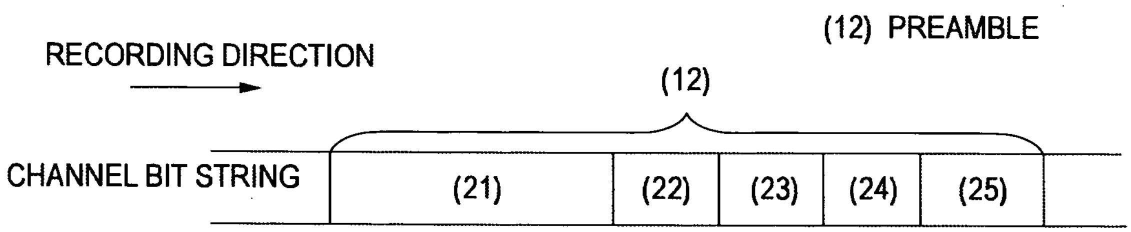


FIG. 9

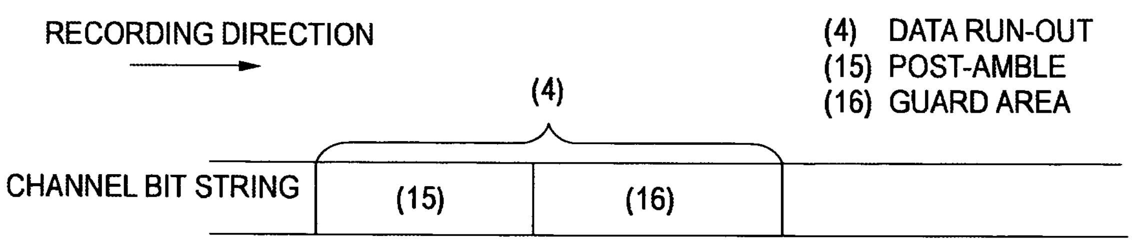


FIG. 10